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ABSTRACT

Little research has been conducted related to the integration of notetaking as an instructional strategy into computer-based instruction (CBI). This report studies the effect of computer-based notetaking on both achievement and instructional completion time. Background information is provided on both CBI and notetaking, and the problem of developing effective computer-based instruction is examined. A study was conducted where notetaking was added to computer-based instruction. The strategy involved forced notetaking where students were not allowed to advance instruction until notes had been taken. The purpose of the study was to test the effects on both achievement and time of forced notetaking and optional notetaking when incorporated into CBI. Eighty-one Eastern Illinois University undergraduate novice students participated in the first test, and 53 undergraduate expert students participated in the second test. Students were randomly assigned to one of three groups: forced notetaking, optional notetaking, or a control group with no notetaking. The lesson was an instructional unit on the human heart, accompanied by terminology and comprehension tests. Students were allowed to review their notes before the tests were administered. Software was adapted to collect student responses during evaluation, collect typed notes, and keep track of time spent on the instructional unit. Results showed that achievement of the treatment groups, optional and forced notetakers, was significantly better than that of the control group, non-notetakers. The forced notetaking group performed slightly, yet statistically significantly, better on the posttest than the optional group. (Contains 16 references.) (MAS)

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# Something New About Notetaking: A Computer-based Instructional Experiment

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## Introduction

Notetaking as an instructional strategy has had little research conducted related to its integration into computer-based instruction (CBI). The fashionable phrase related to CBI is interactive. Notetaking has been lauded for its ability to increase student activity in the learning process. It would seem a natural progression of notetaking to move into CBI, but documented studies and instructional development experiences are lacking.

Notetaking has often been studied determining the effects of its process or product attributes. Consideration is given to notetaking's media attribute by studying its effect on both achievement and instructional completion time when part of CBI.

### Computer-Based Instruction

The focus for most current education research is centered around improving learning, and to do so, educators attempt to facilitate the information processing of the learner. In theory, the media by which instruction is delivered should not have an effect on the learning process. Clark (1983) attributes differences in learning from instruction delivered via different media more to the design of the instruction or to the novelty effects of new media.

The challenge to education is to make media selections that are appropriate, cost effective, and which will provide the greatest educational benefit. Computers in education have proven themselves to be a very flexible medium, able to adapt to a variety of uses and thus offering instructional designers many attributes in one medium.

When computer-based instruction is used for an individualized instruction setting, it offers students experiences which may only be available through a personal level of interaction. Research on computer-based instruction has generally shown that it is at least as effective as other instructional delivery methods but cannot claim to be better (Kulik, Bangert, & Williams, 1983); however, well developed computer based lessons can be effective instruction (Kulik, Kulik, & Schwalb, 1986).

### Notetaking

Notetaking has been proven to be helpful with information processing (Ladas, 1985). Carrier (1983) found that teachers and students alike place a high degree of importance on notetaking as part of effective learning. Students almost universally employ notetaking during lecture, "even though they have never been explicitly instructed to do so - this seems to indicate that some importance is attached

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to notetaking" (Hartley & Marshall, 1974, p. 225). Students believe that the taking of notes will improve their recall of information and that they will perform better on examinations. It has been noted that students have been upset at their inability to take notes or frustrated with insufficient notetaking time during research experimentation (Hartley & Marshall, 1974; Reese, 1984). Much of the research conducted on notetaking supports the idea that learning is facilitated through the notetaking process and by note review.

Virtually all of the research has been conducted on paper and pencil notetaking and not on computer-based notetaking. Some research studies have used the computer to assist notetaking during text reading (Monty, 1991), or to assist the organization of traditional class notes (Grubaugh, 1985). Neither of these studies were set in computer-based instruction. Only Wambaugh (1991) has completely integrated instruction on a computer with a built-in notetaking facility. In his treatment, Wambaugh provided space on each screen where the student could enter information, just as would be done on paper; simultaneously the notes were collected on one screen, but the review of notes was not allowed before testing.

Whether notetaking is part of computer-based instruction, used in conjunction with computers, or in the traditional lecture setting, the strongest directive has been to tell students to take notes. The notetaking process has virtually been left in the total control of the notetaker.

Although notetaking may not be the most enjoyed aspect of education, most students engage in it unquestioningly. In general, taking notes does in some way enhance the learning process and gives those students who take notes a learning advantage over those who do not (Carter & Van Matre, 1975; Kiewra, 1985a).

**Problem**

Given the same amount of effort toward instructional development, computers are effective as instructional delivery resources. The problem with developing instruction for computers has been using methods and strategies that are effective.

Notetaking has been shown to be an effective learning strategy related to academic achievement through both the process of taking notes and the product of taking notes. Kiewra (1985a) observes that research has mostly focused on the process of notetaking by developing and studying notetaking techniques. The product of notetaking has been paper based and research "has not thoroughly investigated how to facilitate and enhance those functions" (p. 245).

Adding a notetaking facility in computer-based instruction provided an opportunity to test an instructional strategy that could only be achieved in a computer environment. This strategy was forced notetaking where the student was not allowed to advance the instruction until notes had been taken.

Not only had computerized notetaking been little tested, but forcing a student to take notes appeared to have been untested to date. The purpose of this study was to test the effects on both achievement and time of forced notetaking and optional notetaking when incorporated into computer-based instruction.

Experiment

A computer-based instructional experiment was conducted at Eastern Illinois University using 81 undergraduate novice students in one test and 53 undergraduate expert students in a second test. Students were randomly assigned to one of three groups: control group, optional notetakers, or forced notetakers.

The lesson content selected for this study was The Human Heart and its Functions (Dwyer, 1972; Dwyer & Lamberski, 1980). The content is an instructional unit describing the human heart, its parts, and the internal processes that occur during the systolic and diastolic phases. It consists of three sections: 1) Parts of the Heart, 2) Circulation of Blood through the Heart, and 3) Cycle of Blood Pressure through the Heart. Selection of this instructional material was based on its use in several previous research studies which creates a body of supportive analysis for its tests' reliability. The lesson was accompanied by a "terminology" (Dwyer, 1972, p. 124), and a "comprehension" (p. 128) test, each of which contains 20 questions. The lesson was adapted into a computer-based lesson using HyperCard software.

The computer-based lesson was developed in HyperCard on a Macintosh at The Pennsylvania State University's Department of Instructional Systems. The software was adapted to collected student responses during the evaluation, to collected typed notes, and to kept track of the time each subject spent on the instructional unit. After the instruction, the computer presented the knowledge level test. In Dwyer's (1978) previous research, test reliabilities were 0.83 for the "terminology" test and 0.77 for the "comprehension" test. The tests required students to have a thorough understanding of the heart, its parts, its internal functioning, and the simultaneous processes occurring during the heart's systolic and diastolic phases.

The test was administered at the end of the instruction. Before students took the test, a simple math problem was presented, a tactic used to empty short term memory and prevent continued rehearsal. By dumping short term memory, students needed to rely on long term memory to answer the questions correctly.

The computer tracked total time for each student on the lesson portion of the instruction only.

Procedures

Upon entering the computer lab, students could choose to use any computer. The first stack they used, called Beginning, chose which treatment they would get. The stack rotated the treatments consecutively (first control, then optional notetaking, and then forced notetaking) so that the next student using any given machine had a different treatment from the previous student. The beginning of the experiment had the treatments staggered as to which treatment the rotation began. This served to assign the students evenly to the various groups and prevented any treatment from having a proportionally larger group of subjects.

After the instructional unit was completed the notetaking groups were allowed to review their notes for five minutes. The notetaking students chould choose to leave the review before five minutes were up, while the control group immediately left the instruction.

Treatments

In all treatments subjects received the identical lesson content and posttest. Two treatments were employed in the study:

1) Forced notetaking,

2) Optional notetaking, and the

Control group with no notetaking.

The notetaking conditions differed in that a phrase reminding the subjects of the notetaking requirement appeared to the forced notetaking group if a subject tried to continue the instruction without taking notes. Subjects were required to write at least five words. The optional group was only directed to take notes at the beginning of the instruction. In both notetaking groups, students typed notes using the keyboard.

During the lesson, students had access to only one button, a forward button to advance the instruction. Learners in the notetaking treatment groups were allowed to create and modify their notes as they progressed through the lesson. Learners were always able to see all their notes, and were given a five minute review period before advancing to the test; however, they did not have access to their notes during the posttests, and were not allowed to retreat to the lesson.

Forced Notetaking Group

The forced notetaking group typed notes about the lesson content into the notetaking field provided on every screen. If a subject attempted to proceed without taking notes a message appeared indicating that at least five words had to be entered about the content before they could continue. And in fact, the lesson would not advance until five words were entered into the notetaking field.

Optional Notetaking Group

The optional notetaking group appeared to be essentially the same as the forced group, but was not required to take notes. Subjects were directed to take notes only at the beginning of the instruction.

Control Group

The control group did not have an opportunity to take notes during the lesson.

**Results**

The novice subject tested showed significant differences between all three groups based of instructional time and on achievement. The expert subjects tested showed significant difference between all groups for the instructional time but only a difference between control and forced groups on achievement.

The achievement differences for the experts subjects were mostly due to differences in variances. The novice subjects had significant differences based on mean scores.

**Discussion**

Notetakers vs. Non-notetakers

Notetaking in a computer environment seems to provide the same learning advantage as evidenced in traditional notetaking methods. The results of this study are consistent with those of traditional notetaking where the achievement of the treatment groups, optional and forced notetakers, was significantly better than that of the control group, non-notetakers.

It has been assumed that notetaking aids information processing by building and reinforcing links between old information and new (Ladas, 1980). At the same time, having notes for review has been shown to be effective in increasing learners' ability to achieve (Kiewra, 1985b). Both the process and product of notetaking attempt to meet the same goal, improve learning by aiding the encoding process. The process of notetaking facilitates encoding during the instruction, while the product of notetaking allows encoding and the practice of associations to occur after the instruction is completed.

This study was designed to force some treatment subjects to take notes while it allowed others the chance to take notes, and it provided both treatment groups the opportunity to review their notes before the posttest. This study treated notetaking as a single function, i.e., did not separate the functions of process and product. Carter and Van Matre (1975) stated that the combination of notetaking process and product are most beneficial for learning than either function separately. That is why both functions were designed into this study.

Forced vs. Optional Notetaking

The optional notetaking treatment operated much like traditional notetaking in that subjects could choose when to take notes and how many notes to take. Providing the element of choice made this group more varied in their use of notes. Three of the novice subjects had completion times at or below the control group's mean time of 13.5 minutes. This seems to indicate that they took few, if any notes while four other novice subjects exceeded the forced group's mean time of 54.2 minutes, showing that some subjects in this treatment took extensive notes.

The optional notetaking group had a significant learning advantage over the control group. This should be expected since the design of this treatment reflected a traditional style of notetaking. Before the current study, it was unclear what effect forced notetaking would have on achievement. The results were positive, with the forced notetaking group performing slightly, yet statistically significantly, better on the posttest than the optional group.

Forcing an individual to take notes is a thoroughly new variable which can only be achieved with the aid of computer-based instruction. The computer environment allows users to be monitored, measuring whether or not they take notes and, if so, how much they have entered in the notetaking area. In the present study, the taking of notes was judged by quantity, requiring the subject to have five or more words in the notetaking area. The quality of content was not monitored or measured.

Forcing an individual to take notes is much different than mandatory notes or required notes. In both of the latter cases the only way to guarantee that notes have been taken is to review the notes after the fact. Questions of concern while reviewing the notes are: were the notes created by this student, and when

did the student take the notes, during instruction or at some later time separate from instruction? Computer-based notetaking in computer-based instruction virtually insures that the notes taken are by the student using that lesson.

Subjects forced to take notes spent a considerable amount of time on the lesson. For that time spent, this group did have higher achievement on the posttest. Perhaps by forcing notetaking, subjects created more links between old and new content, or they had more forced rehearsals.

Implications for Use in Computer-Based Instruction

There are three implications for the design and use of computer-based notetaking in computer-based instruction as a result of the outcomes of this study. First, computer-based notetaking is an effective strategy for facilitating information processing within computer-based instruction. Incorporating notetaking in computer-based instruction can enhance the encoding of information. There may be a variety of methods by which computer-based notetaking should be designed into instruction including: an unlimited review period, allowing students' notes to be printed, adding an element of guidance for the notetaking process, having the notetaking facility hidden from view and having students request its use, and allowing the copying of text into notes.

Second, forced notetaking may have advantages for learning. Subjects in the optional notetaking treatment commented that many screens seemed to have repetitive content, therefore they did not take notes on every screen. This study forced the taking of notes on every content screen. Design consideration should be given to when notes will be forced and when they will be optional.

Third, forced notetaking could be strengthened by developing the ability to monitor users' content rather than using quantity as the measure. Although students did not take time to defeat the forced system, doing so would be quite easy and could turn the forced user into an optional user by inputting five nonsense words or even nonwords.

Implication for Future Research

Reflecting on the results of this study, the field of notetaking, and the newer area of computer-based notetaking, it is obvious that, as Ganske (1981) noted, not enough investigation has been done on a broad range of variables related to notetaking. That alone should be enough to stimulate new research, but now adding to the process and product of notetaking is a mediated variable which causes one to rethink the use, importance and place for notetaking. There is a need to replicate this study where the content is related to a real class. This may show a change in the way the optional and forced notetaking group approaches selection of content for notetaking. The positive effects of the forced notetaking group may disappear when students have the motivation to study real classroom content.

**Conclusion**

This study is consistent with other studies that have tested a variable of notetaking against a non-notetaking group. Although it is not viable to make a blanket statement about the effectiveness of forced notetaking, it does stand true for this investigation that forced notetaking did improve achievement on an immediate posttest.

Computer-based notetaking is a different way to take notes. It possibly will require students to develop a different schema to make the best use of this strategy.

It is difficult to make generalizations about the efficacy of forced notetaking based on one study; however, the results are encouraging for its use in computer-based instruction. Continued studies investigating the use of forced notetaking may prove it to be an effective attribute of CBI construction. The ultimate objective of this investigation was to study a new method of notetaking which may facilitate the process of notetaking and encoding, and provide the product of notetaking, i.e., notes for review. The use of computers in the classroom continues to grow. Traditional instructional methods which have proven effective in the classroom need to be adapted into the computer-based instruction environment. Notes are only the by-product; the focus of future investigation should be on ways to facilitate information processing.

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